Mar 2nd, 10:30 AM

Session 1C

Kentucky Water Resources Research Institute, University of Kentucky

Kentucky Water Resources Research Institute, University of Kentucky, "Session 1C" (2009). *Kentucky Water Resources Annual Symposium*. 4.
https://uknowledge.uky.edu/kwrri_proceedings/2009/session/4

SUSPENDED SEDIMENT IN THE DRY CREEK WATERSHED, ROWAN COUNTY, KENTUCKY

Samuel Williams[+], Steven K. Reid[+], Christine McMichael[#]
+ Earth System Science Program, Department of Physical Sciences, Morehead State University; # Institute for Regional Analysis and Public Policy, Morehead State University; Morehead, Kentucky 40351
(606) 783-5293
skwill01@moreheadstate.edu

The 2007 Kentucky Environmental and Public Protection Cabinet list of impaired streams identifies a segment of Dry Creek from its mouth to 0.5 miles upstream as partially supporting aquatic life due to sedimentation/siltation and organic enrichment (sewage). Urbanization in the Dry Creek watershed is accelerating. Data collected between March 2007 and January 2009 provide a snapshot of suspended sediment concentrations (SSC), suspended sediment loads, and suspended sediment yields within the Dry Creek watershed. Results have been combined with field reconnaissance to identify sources and land uses that apparently contribute to impairment by sedimentation/siltation.

Suspended sediment sampling used the methods of Edwards and Glysson (1998). Whenever possible, the equal-width-increment method and DH-48 sampler were used. Very high or low discharge events required the use of dip or single vertical sampling. Suspended sediment analysis followed procedures of ASTM D3977-97 and Guy (1969). Discharge was measured using the velocity-area method or neutrally buoyant object method (Rantz et al., 1982) depending on flow conditions.

SSC values range from 0 to 341.30 mg/L for days when all sites were visited (Figure 1). Instantaneous suspended sediment loads range from 0 to 510 tons/day for days when all sites were visited (Figure 2). Sediment yields range from 5.00×10^{-6} to 1.68×10^{-1} tons/day/acre for days when all sites were visited (Figure 3).

Graphical results can be related to different geomorphic conditions and land uses identified through field reconnaissance. Site NB samples the upper 56% (4900 ac) of the Dry Creek watershed, which includes headwater areas and is generally the least developed portion of the basin. High SSC and loads at site NB (Figures 1, 2) probably reflect excessive stream bank erosion upstream. Morgan Fork, a tributary of Dry Creek, usually displays very high SSC, loads, and yields compared to other sampling sites in the watershed (Figures 1, 2, 3). Examination of the highest discharge event sampled to date indicates that Morgan Fork (MF) contributed nearly half of the sediment load to the next downstream site (PO), the sampling site closest to the mouth of Dry Creek (Figure 4). Sediment yield for Morgan Fork is extreme compared to other sites (Figure 5) despite the fact that Morgan Fork represents only 15% (1300 acres) of the entire Dry Creek watershed (8800 acres). The very high suspended sediment yield from Morgan Fork reflects poor land use and inadequate erosion mitigation practices prior to and during recent highway construction in the Morgan Fork watershed.

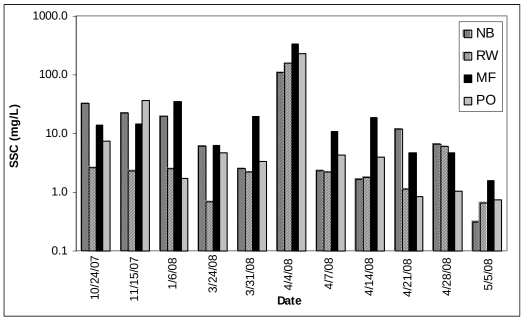

Figure 1. Comparison of suspended sediment concentrations on dates when all sites were sampled.

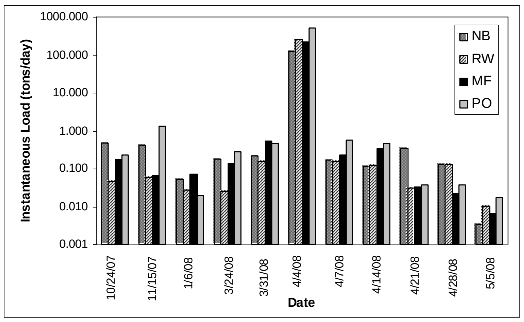

Figure 2. Comparison of instantaneous loads for dates when all sites were sampled.

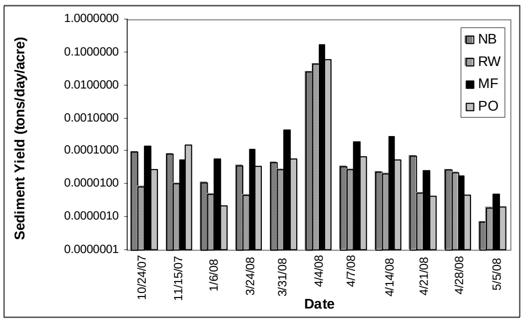

Figure 3. Comparison of sediment yields on dates when all sites were sampled.

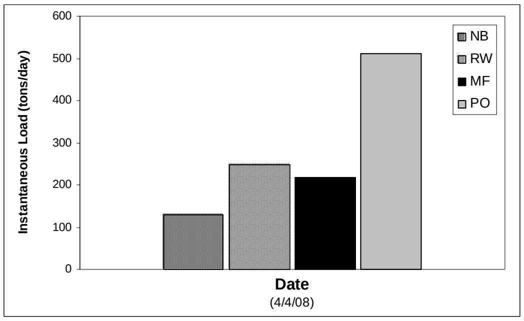

Figure 4. Comparison of instantaneous loads for all sites during highest discharge event.

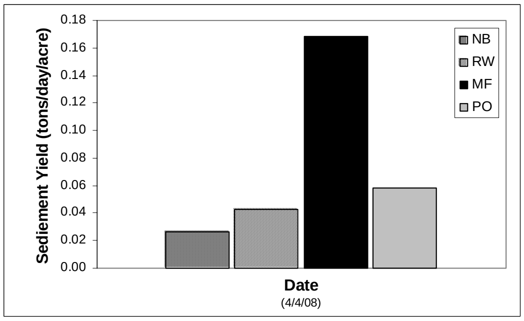

Figure 5. Comparison of sediment yield for all sites during highest discharge event.

Results of this study have led to a new study involving bank-pinning and measurement of channel cross-sections to quantify sediment contributions due to bank instability and erosion along Dry Creek. In addition, a focused study of the impact of recent highway construction has been initiated.

INFLUENCE OF EASTERN HEMLOCK (*Tsuga canadensis*) ON THE AQUATIC BIODIVERSITY IN EASTERN KENTUCKY

Aric J. Payne and Sherry L. Harrel PhD
Department of Biological Sciences
Memorial Science Building, Room 232A
Richmond, Kentucky 40475
(706) 633-0805
aric_payne19@eku.edu, sherry.harrel@eku.edu

This research experiment is aimed at comparing the aquatic diversity between fish and macroinvertebrate assemblages in eastern hemlock dominated forests and hardwood dominated forests. The eastern hemlock (*Tsuga canadensis*) plays a unique role in the eastern forest landscape, occupying ecological niches not easily filled by other tree species. It is an extremely long-lived and shade-tolerant conifer that grows in dense stands, creating an environment that is characterized as a cool, damp microclimate with low light levels and depauperate understory vegetation cover (Lutz 1928; Rogers 1978, 1980). *T. canadensis* is one of the principle riparian and cove canopy species in the Southern Appalachian Mountains and commonly the only evergreen canopy species in mesic sites. Therefore, it is likely an important species in terms of direct and indirect effects on hydrologic processes (Ford et al. 2007). Consequently, plant and animal species may have evolved in association with hemlock stands and may be dependent upon them for habitat (Ross et al. 2003).

Recently, *T. canadensis* forests have been rapidly declining due to the introduction of the hemlock woolly adelgid (HWA, *Adelges tsugae*), a small aphid-like insect. First discovered in West Virginia in the 1950's, *A. tsugae* has now spread in hemlock stands along the east coast north through southern New England. Since its introduction, the adelgid has created extensive decline and mortality of *T. canadensis* in Virginia, Pennsylvania, New Jersey, and Connecticut (Orwig and Foster 1998). In March 2006, *A. tsugae* was found in Harlan County, Kentucky and since, has spread to Pike, Leslie, Letcher, Clay, and Bell Counties. With the rapid movement of the adelgid in only a few years, it can be expected that the adelgid will continue to move throughout hemlock forests located in eastern Kentucky.

Much research has been conducted on terrestrial communities associated with eastern hemlock forests, however, little emphasis has been placed on investigating aquatic communities. To determine the potential long-term impacts of hemlock forest decline on aquatic biodiversity, we conducted a comparison study of streams in the Daniel Boone National Forest on fish and macroinvertebrate communities, along with stream habitats. We found fish community structure to be distinctive to its correlating forest composition. Streams draining hardwood forests were more diverse and more productive than streams draining hemlock forests. In addition, there were distinct differences in fish trophic structure, with predators more common and insectivores less common in hemlock streams. Conversely, insectivores were more common and predators were less common in hardwood streams. Stream temperature data indicated that streams draining hemlock forests were an average 4°C cooler during summer months than hardwood streams. When compared to other literature, it is suggested that hemlock streams are cooler in the summer months and warmer in the winter months, maintaining more stable hydrologic and thermal regimes. In conclusion, our findings suggest that the expected decline of the eastern hemlock in Kentucky may result in long-term ecological impacts on aquatic biodiversity.

IDENTIFICATION OF HUMAN AND ANIMAL FECAL SOURCES IN CENTRAL KENTUCKY WATERSHEDS BY PCR OF 16sDNA MARKERS FROM HOST-SPECIFIC FECAL ANAEROBES

Tricia Coakley[1,2], Gail Brion[1,3], and Alan Fryar[2]

[1]ERTL, Univ. of Kentucky, 161 Raymond Bldg., Lexington, KY 40506-0281
[2]Earth & Env. Sciences, Univ. of Kentucky, 101 Slone Bldg., Lexington, KY 40506-0053
[3]Civil Engineering, Univ. of Kentucky, 161 Raymond Bldg., Lexington, KY 40506-0281

(859) 257-6757
tcoakley@engr.uky.edu

Lexington and other communities in Kentucky are experiencing problems associated with increased fecal bacterial loads in storm water runoff and surface water tributaries, which raise the *E. coli* concentrations above regulatory limits. The sources of these fecal pollutants must be identified before the concentration levels can be decreased. This study was designed to investigate multiple proposed indicators for fecal source identification and apportionment in a local watershed impacted by numerous and varied sources. Samples were analyzed for *Bacteroides* source-specific genetic markers, *E. coli*, and the ratio of atypical colonies (AC) to total coliforms (TC) for the purpose of determining source, load, and relative age of the fecal contaminants, respectively. This study will also determine the usefulness of the *Bacteroides* 16sDNA markers to pinpoint the presence of human sewage in an urban watershed and to quantitatively apportion the impact of humans versus other animals.

A total of 31 samples were analyzed from Wolf Run, Cane Run, and Glenn's Creek watersheds in Fayette, Scott, and Woodford counties. *E. coli* was enumerated by a most probable number method using Idexx colilert™ media and quantitray 2000™ bubble packs. AC/TC ratios were determined from the total coliform and atypical colony counts on m-Endo media at multiple dilutions. *Bacteroides* genetic markers are identified and quantified using the Allbac, Hubac, and Bobac primers and probes developed by Alice Layton at the University of Tennessee Center for Environmental Biotechnology with a BioRad iCycler IQ™ real-time PCR instrument.

Preliminary results show that fecal loads, as indicated by *E. coli* enumerations, are variable and range from 10 to 17,329 MPN/100mL. The Allbac genetic marker (non-host- specific, general fecal marker) is ubiquitous across the samples analyzed and its concentration is proportional to the *E. coli* concentration. The human-specific *Bacteroides* marker, Hubac, is found across the study area and concentrations are variable. Work is ongoing to elucidate the apportionment of general, human and bovine sources in these watersheds.

NOTES

INVESTIGATION OF LAND-USE CHANGE AND HYDROLOGIC FORCING UPON STREAMBANK EROSION AND IN-STREAM SEDIMENT PROCESSES USING A WATERSHED MODEL AND SEDIMENT TRACERS

Joseph Russo
Research Associate
Department of Civil Engineering
University of Kentucky
161 O. H. Raymond Bldg.
Lexington, KY 40506-0281
Phone: (859) 257-4093
Email: joseph.russo@uky.edu

Jimmy Fox
Assistant Professor
Department of Civil Engineering
University of Kentucky
161 O. H. Raymond Bldg.
Lexington, KY 40506-0281
Phone: (859) 257-8668
Email: jffox@engr.uky.edu

The production of sediment from sources in the stream corridor including the banks and bed of the river remains a topic of research that needs further investigation for the environmental water resources community. Few researchers have been able to integrate sediment transport from stream banks and stream beds successfully into a watershed scale model. The nature of this work is to numerically model sediment transport processes, including stream bank erosion and in-stream storage, with a watershed scale model in order to better understand the sensitivity of these processes to land-use change and hydrologic forcing. The novelty of the modeling approach is that improved equations for streambank erosion and in-stream sediment resuspension and deposition are formulated within an existing watershed sediment transport model, and these new equations are calibrated using sediment fingerprinting modeling results based on carbon and nitrogen stable isotope tracers to quantify sediment loading from streambanks and streambeds. The South Elkhorn Watershed, located in the Bluegrass Region of Kentucky, was chosen to be modeled because of the dominance of streambank erosion and stored fine sediments impacting this system and the availability of historic sediment tracer and sediment loading data from a previous study. The existing watershed model that is modified is the Hydrologic Simulations Program-FORTRAN model. The modified model is calibrated using the sediment fingerprinting results and sediment loading measurements taken over a three year period. After calibrating the model, a sensitivity analysis is run to discover which parameters control bank and bed erosion and transport in the model in both a distributed sense throughout the watershed and from an integrated loading perspective.

The results of this study are expected to aid in our understanding of watershed and climate disturbance upon sediment, advance modeling of the watershed including calibration of source processes, predict future problem with ever increasing urban development, and determine to what extent a sediment erosion problem already exists.